WirelessCo Cost Sharing Report

1.0 Introduction

It is desired by Sprint to determine the minimum distance a PCS base station can co-exist with an incumbent microwave system. Comsearch was given a set of default PCS base station parameters and terrain assumptions to be used in calculating the minimum distance. Basic microwave assumptions were made by Comsearch in order to have a reference for the calculation. Both CDMA and TDMA PCS technologies were considered.

2.0 Assumptions

The following section describes the assumptions used in the calculation, both for the PCS base station and the microwave site. The analysis was performed for eight (8) radials emanating from the microwave site at zero, 45, 90, 135, 180, 225, 270 and 315 degrees. Comsearch started at the base station and continued outward away from the microwave site placing a PCS base station at a fixed interval per Sprints suggestion. The PCS base station was marked if it exceeded the calculated maximum interference level allowed by the microwave receiver. All sites that were marked as an interfering site were than counted and divided by the total number of site considered to determine if they fell in the 95% interference category. As the interference percentage values changed as the PCS site moved away from the microwave receiver, Comsearch used the value that was as close to 95% as possible as the point for the minimum distance for co-existence.

2.1 PCS Base Station Assumptions

Base Station Antenna Height	100 feet AGL (30.48 m)
Base Station Antenna Type	Omni
Base Station Antenna Gain	10.0 dBi
Base Station EIRP	50 dBm

The placement of each base station was 1.5 miles apart at the top, mid point, and valley of an assumed hilly sinusoidal terrain. Both a 200 KHz TDMA and a 1.25 MHz CDMA signal was considered in the analysis.

2.2 Microwave Site Assumptions

MW Antenna Type	FCC Standard A (Andrews Corp. P8F-18C)			
MW Antenna Height	160 feet AGL (48.768 m)			
MW Effective Antenna Height	210 feet AGL (64 m)			
MW Antenna Gain	31.2 dBi			
MW Antenna Loss	0 deg	0 dB	180 deg	39 dB
	45 deg	32 dB	225 deg	42 dB
	90 deg	31 dB	270 deg	31 dB
	135 deg	42 dB	315 deg	32 dB
MW Receiver Loss	3.5 dB			
MW Receiver Type	Farinon FAS-2000 480 Channels Analog			
Filter Considered	12 MHz IF Bandwidth			

Since the antenna was symmetrical about the zero axis (45 deg = 315 deg loss values, etc.), Comsearch only calculated distances for the radials from zero to 180 degrees.

3.0 Results of The Analysis

Based on the assumptions listed above, the following results were recorded:

With No Tree Loss Added

Azimuth (deg.):	zero	45	90	135	180	Avg	Imax(dBm)
TDMA Dist.(km)	**339**	**31.4**	**31.4**	**19.3**	**24.1**	**65.9**	**-109.8**
# of Sites	280	25	25	15	19		
% Point Used	.95	.96	.96	.933	.947		
CDMA Dist.(km)	**249**	**26.6**	**26.6**	**14.5**	**19.3**	**50.4**	**-105.7**
# of Sites	205	21	21	11	15		
% Point Used	.951	.952	.952	.91	.933		

With 4 dB of Tree Loss Added

Azimuth (deg.):	zero	45	90	135	180	Avg	Imax(dBm)
TDMA Dist.(km)	**249**	**26.6**	**26.6**	**14.5**	**19.3**	**50.4**	**-109.8**
# of Sites	205	21	21	11	15		
% Point Used	.951	.952	.952	.91	.933		
CDMA Dist.(km)	**194**	**20.5**	**24.1**	**2.4**	**14.5**	**37.9**	**-105.7**
# of Sites	160	16	19	1	11		
% Point Used	.95	.94	.95	1.0	.91		

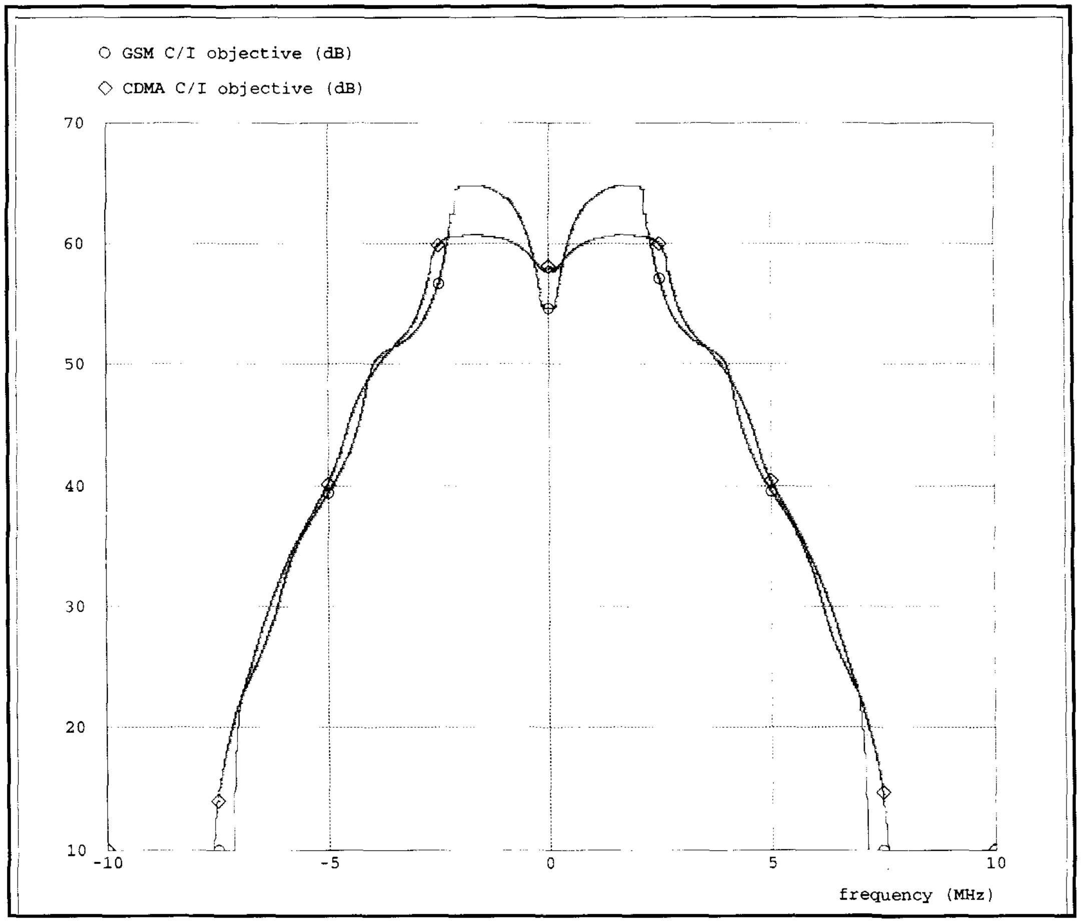
With 6 dB of Tree Loss Added

Azimuth (deg.):	zero	45	90	135	180	Avg	Imax(dBm)
TDMA Dist.(km)	**220**	**25.3**	**25.3**	**2.41**	**15.7**	**42.7**	**-109.8**
# of Sites	181	20	20	1	12		
% Point Used	.95	.95	.95	1.0	.92		
CDMA Dist.(km)	**170**	**19.3**	**20.5**	**2.41**	**2.41**	**32.1**	**-105.7**
# of Sites	140	15	16	1	1		
% Point Used	.95	.933	.94	1.0	1.0		

4.0 Conclusion

The keyhole created by the analysis represents the minimum distance a PCS base station can approach a microwave site and not cause interference with a confidence of 95%. Said a different way, as a PCS base station is brought closer to a microwave receiver, when 95% of total number of sites considered cause interference, the distance is noted. Three distance values were tabulated, one with no tree loss assumed and two cases considering tree loss. The most conservative estimate would be with no tree loss considered; however, at grazing angles the tree tops would cause a dispersion of energy and affect the vertical clearance much like a knife edge in diffraction theory, resulting in about a 4 to 6 dB loss. In cases when the trees would become obstructions they are normally considered to be totally blocking.

GSM_CDMA C/I Objective



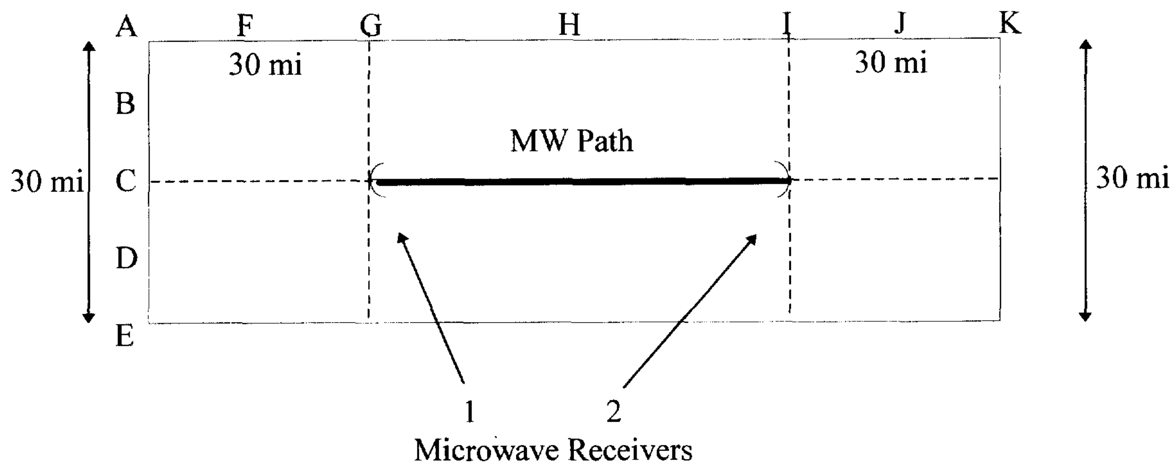
ATTACHMENT B

Sprint Telecommunications Venture
PCS PrimeCo, L.P.
Analysis of Proximity Threshold Trigger

1.0 Introduction

The purpose of this study is to examine the proposed proximity threshold trigger that is being proposed by Sprint Telecommunications Venture (STV), AT&T Wireless, PCS PrimeCo L.P. and GTE for identification of cost sharing obligations for the relocation of the incumbent 1.9 GHz microwave users. Below is the proposed box which is originated from the actual path under consideration with the additional buffers of 30 miles. Any base station constructed within this box is obligated to share in the cost of its migration to another frequency band.

Figure 1 - Proximity Threshold Box



This study will examine the accuracy of this approach with respect to the actual potential for harmful interference into a microwave receiver. Because of the variety of technologies being considered for PCS, both CDMA and TDMA technologies were analyzed in the study. This study considers a Free Space propagation model in the calculations assuming line-of-site between the PCS base station and the microwave antennas. Below are a number of assumptions that were made for the purposes of this study.

2.0 Assumptions

In order to analyze the proximity threshold trigger versus actual potential for harmful interference into a microwave link, assumptions were made for operating parameters of both the PCS base stations and microwave site. Typical averages were incorporated in this study in order to simplify the analysis and to have the results reflect the most probable scenario.

2.1 PCS Base Station Assumptions

Base Station Antenna Height:	100 feet AGL (30.48 m)
Base Station Antenna Type:	Omni-Directional
Base Station Antenna Gain:	10.0 dBi
Base Station EIRP:	50.0 dBm (100 Watts)
Base Station Transmit Signal:	200 kHz TDMA and 1.25 MHz CDMA

A total of thirty-five (35) discrete locations were assumed for the PCS base stations within the proximity threshold box. Each of this points (labeled using a grid system in Figure 1) has been analyzed individually for its contribution of potential interference into the microwave link. Table 1 includes a breakdown of the specific points and their distance and bearing to microwave receivers 1 and 2.

2.2 Microwave Site Assumptions

MW Antenna Type:	FCC Standard A (Andrew Corp. P8F-21C)
MW Antenna Height:	160 feet AGL (48.77 m)
MW Antenna Gain:	31.2 dBi
MW Receiver Losses:	3.5 dB
MW Receiver Type:	Farinon FAS-2000 480 Channel Analog
MW Path Length:	15 miles (24.14 km)
Filter Consideration:	12 MHz IF Bandwidth

For each of the proximity threshold analysis points (A - J) and their respective angles from either microwave receiver 1 or 2, the antenna discrimination and resultant gain were calculated from the manufacturer's antenna patterns. These are also included in Table 1.

3.0 Analysis Methodology

3.1 Propagation Loss

Using the the calculated interfering path lengths from the microwave receivers to each of the proximity threshold analysis points, the Table 2 reflects the calculated propagation loss using the Free Space model.

3.2 Interference Calculations

Using the assumptions made in the Section 2 and propagation losses calculated in Table 2 for each of the proximity threshold analysis points, the following formula were used to calculate the interference signal level from each point into both microwave receivers.

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Itotal:	Total Interference Signal Level from Specific PCS Base Station (dBm)
EIRPb:	PCS Base Station Effective Radiated Power (dBm)
PathLoss:	Calculated Propagation Loss
MWgain:	MW Receive Antenna Gain along the Specific Azimuth (Table 1)
Loss:	MW Receiver Losses (dB)

Itotal = EIRPb - PathLoss + MWgain - Loss

The calculated interference objective for the assumed microwave receiver in Section 2.2 based upon industry accepted guidelines is -105.7 dBm for 1.25 MHz CDMA and -109.8 dBm for 200 kHz TDMA. These values are the maximum interference signal level that can be introduced into the microwave receiver (Imax).

4.0 Analysis Results

Included in Table 3 are the results of the interference calculations into both microwave receiver 1 and 2 from all of the proximity theshold analysis points combining all of the previously defined assumptions and calculations of the interference signal.

Now that these interference signal level values have been computed into each microwave receiver, the worst-case Itotal from each proximity threshold analysis point will be compared to the interference objective (Imax). Both the CDMA and TDMA technologies are considered. Table 4 contains the results of this comparison denoting the margin by which the microwave receiver misses the interference objective.

Based upon these results, the free space propagation model indicates that **100%** of the proximity threshold points analyzed along the box **will** cause harmful interference into the worst-case microwave receiver.

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Table 1 - Distances and Azimuths / Antenna Gains

	Angle From MW Receiver (DTN)		Antenna Discrimination (dB)		Antenna Gain (dBi)		Interfering Path Length (mi)	
Point on Rectangle	Receiver 1	Receiver 2	Receiver 1	Receiver 2	Receiver 1	Receiver 2	Receiver 1	Receiver 2
A	206.6	18.4	43.0	29.0	-11.8	2.2	33.5	47.4
AF	225.0	26.6	43.0	34.0	-11.8	-2.8	21.2	33.5
AG	270.0	45.0	33.0	34.0	-1.8	-2.8	15.0	21.2
AH	296.6	63.4	34.0	34.0	-2.8	-2.8	16.8	16.8
AI	315.0	90.0	34.0	33.0	-2.8	-1.8	21.2	15.0
AJ	333.4	135.0	34.0	43.0	-2.8	-11.8	33.5	21.2
AK	341.6	153.4	29.0	43.0	2.2	-11.8	47.4	33.5
B	194.0	9.5	43.0	22.0	-11.8	9.2	30.9	45.6
BF	206.6	14.0	43.0	26.0	-11.8	5.2	16.8	30.9
BG	270.0	26.6	33.0	34.0	-1.8	-2.8	7.5	16.8
BH	315.0	45.0	34.0	34.0	-2.8	-2.8	10.6	10.6
BI	333.4	90.0	34.0	33.0	-2.8	-1.8	16.8	7.5
BJ	346.0	153.4	26.0	43.0	5.2	-11.8	30.9	16.8
BK	350.5	166.0	22.0	43.0	9.2	-11.8	45.6	30.9
C	180.0	0.0	39.0	0.0	-7.8	31.2	30.0	45.0
CF	180.0	0.0	39.0	0.0	-7.8	31.2	15.0	30.0
CG	NA	0.0	NA	0.0	NA	31.2	NA	15.0
CH	0.0	0.0	0.0	0.0	31.2	31.2	7.5	7.5
CI	0.0	NA	0.0	NA	31.2	NA	15.0	NA
CJ	0.0	180.0	0.0	39.0	31.2	-7.8	30.0	15.0
CK	0.0	180.0	0.0	39.0	31.2	-7.8	45.0	30.0
D	166.0	350.5	43.0	22.0	-11.8	9.2	30.9	45.6
DF	153.4	346.0	43.0	26.0	-11.8	5.2	16.8	30.9
DG	90.0	333.4	33.0	34.0	-1.8	-2.8	7.5	16.8
DH	45.0	315.0	34.0	34.0	-2.8	-2.8	10.6	10.6
DI	26.6	270.0	34.0	33.0	-2.8	-1.8	16.8	7.5
DJ	14.0	206.6	26.0	43.0	5.2	-11.8	30.9	16.8
DK	9.5	194.0	22.0	43.0	9.2	-11.8	45.6	30.9
E	153.4	341.6	43.0	29.0	-11.8	2.2	33.5	47.4
EF	135.0	333.4	43.0	34.0	-11.8	-2.8	21.2	33.5
EG	90.0	315.0	33.0	34.0	-1.8	-2.8	15.0	21.2
EH	63.4	296.6	34.0	34.0	-2.8	-2.8	16.8	16.8
EI	45.0	270.0	34.0	33.0	-2.8	-1.8	21.2	15.0
EJ	26.6	225.0	34.0	43.0	-2.8	-11.8	33.5	21.2
EK	18.4	206.6	29.0	43.0	2.2	-11.8	47.4	33.5

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Table 2 - Propagation Losses

	Interfering Path Length (mi)		Propagation Loss (dB)	
Point on Rectangle	**Receiver 1**	**Receiver 2**	**Receiver 1**	**Receiver 2**
A	33.5	47.4	136.8	139.9
AF	21.2	33.5	132.9	136.8
AG	15.0	21.2	129.9	132.9
AH	16.8	16.8	130.8	130.8
AI	21.2	15.0	132.9	129.9
AJ	33.5	21.2	136.8	132.9
AK	47.4	33.5	139.9	136.8
B	30.9	45.6	136.1	139.5
BF	16.8	30.9	130.8	136.1
BG	7.5	16.8	123.8	130.8
BH	10.6	10.6	126.8	126.8
BI	16.8	7.5	130.8	123.8
BJ	30.9	16.8	136.1	130.8
BK	45.6	30.9	139.5	136.1
C	30.0	45.0	135.9	139.4
CF	15.0	30.0	129.9	135.9
CG	NA	15.0	NA	129.9
CH	7.5	7.5	123.8	123.8
CI	15.0	NA	129.9	NA
CJ	30.0	15.0	135.9	129.9
CK	45.0	30.0	139.4	135.9
D	30.9	45.6	136.1	139.5
DF	16.8	30.9	130.8	136.1
DG	7.5	16.8	123.8	130.8
DH	10.6	10.6	126.8	126.8
DI	16.8	7.5	130.8	123.8
DJ	30.9	16.8	136.1	130.8
DK	45.6	30.9	139.5	136.1
E	33.5	47.4	136.8	139.9
EF	21.2	33.5	132.9	136.8
EG	15.0	21.2	129.9	132.9
EH	16.8	16.8	130.8	130.8
EI	21.2	15.0	132.9	129.9
EJ	33.5	21.2	136.8	132.9
EK	47.4	33.5	139.9	136.8

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Table 3 - Interference Calculation Results

	Calculated Itotal into MW Receiver (dBm)	
Point on Rectangle	**Receiver 1**	**Receiver 2**
A	-102.1	-91.2
AF	-98.2	-93.1
AG	-85.2	-89.2
AH	-87.1	-87.1
AI	-89.2	-85.2
AJ	-93.1	-98.2
AK	-91.2	-102.1
B	-101.4	-83.8
BF	-96.1	-84.4
BG	-79.1	-87.1
BH	-83.1	-83.1
BI	-87.1	-79.1
BJ	-84.4	-96.1
BK	-83.8	-101.4
C	-97.2	-61.7
CF	-91.2	-58.2
CG	NA	-52.2
CH	-46.1	-46.1
CI	-52.2	NA
CJ	-58.2	-91.2
CK	-61.7	-97.2
D	-101.4	-83.8
DF	-96.1	-84.4
DG	-79.1	-87.1
DH	-83.1	-83.1
DI	-87.1	-79.1
DJ	-84.4	-96.1
DK	-83.8	-101.4
E	-102.1	-91.2
EF	-98.2	-93.1
EG	-85.2	-89.2
EH	-87.1	-87.1
EI	-89.2	-85.2
EJ	-93.1	-98.2
EK	-91.2	-102.1

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Table 4 - Results

		Misses Imax Objective By: (dB)	
Point on Rectangle	**Calculated Itotal (dBm)**	**CDMA**	**TDMA**
A	-91.2	14.5	18.6
AF	-93.1	12.6	16.7
AG	-85.2	20.5	24.6
AH	-87.1	18.6	22.7
AI	-85.2	20.5	24.6
AJ	-93.1	12.6	16.7
AK	-91.2	14.5	18.6
B	-83.8	21.9	26.0
BF	-84.4	21.3	25.4
BG	-79.1	26.6	30.7
BH	-83.1	22.6	26.7
BI	-79.1	26.6	30.7
BJ	-84.4	21.3	25.4
BK	-83.8	21.9	26.0
C	-61.7	44.0	48.1
CF	-58.2	47.5	51.6
CG	-52.2	53.5	57.6
CH	-46.1	59.6	63.7
CI	-52.2	53.5	57.6
CJ	-58.2	47.5	51.6
CK	-61.7	44.0	48.1
D	-83.8	21.9	26.0
DF	-84.4	21.3	25.4
DG	-79.1	26.6	30.7
DH	-83.1	22.6	26.7
DI	-79.1	26.6	30.7
DJ	-84.4	21.3	25.4
DK	-83.8	21.9	26.0
E	-91.2	14.5	18.6
EF	-93.1	12.6	16.7
EG	-85.2	20.5	24.6
EH	-87.1	18.6	22.7
EI	-85.2	20.5	24.6
EJ	-93.1	12.6	16.7
EK	-91.2	14.5	18.6

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